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AUTHOR Pietras, Jesse John
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ABSTRACT

This overview of educational telecommunications and distance learning in Connecticut includes information on the Connecticut Department of Education and the Connecticut Public Television statewide, two-channel, ITFS (instructional television fixed service); the Connecticut Community College system's Community College Instructional Television microwave-delivered educational network; and the Area Cooperative Educational Services bi-directional, fully interactive educational services using electronic mail and video conferencing. Issues involved in maintaining quality of educational programming standards through regulation by the Department of Public Utility Control, as prescribed by proposed state legislation, Public Act 92-146, are then discussed. The report also describes the trial of the Southern New England Telephone (SNET) video distance learning program, "Links to Learning," from 1988-1990; current collaboration of SNET with the National Foundation for the Improvement of Education (NFIE) in sponsoring the "Learning Tomorrow" program, an outgrowth of "Links to Learning"; the prospects of cable company involvement; the evolution of fiber optic cable; and opportunities for fiber optic cable uses in education. Seven tables provide information on Connecticut CATV franchise holders and SNET "Links to Learning" school locations; diagrams of a basic network system, a two-way interactive classroom, and the evolution of fiber optics in cable; a list of cable classroom equipment costs and a four year acquisition plan; and a summary list of distance learning technologies. (Contains 31 references.) (ALF)

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Regulatory Reform and CATV/TELCO Distance Learning Initiatives in Connecticut

A Paper Presented to the Educational Resources Information Center Clearinghouse on Informational Resources, Syracuse, New York

Jesse John Pietras
Connecticut Dept. Of Public Utility Control
Telecommunications Division

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Connecticut Educational Telecommunications: An Overview

Distance learning in Connecticut has begun to develop in the wake of telecommunications infrastructure modernization. Two essential components of any distance education protocol are the maximization of student to teacher interaction and the determination of the major remote education players.1 Connecticut has not yet adopted a standardized policy governing the delivery of educational telecommunications programming.2 Various independent, unregulated entities currently provide remote education services throughout the state. **SciStar**, for example, is a microwave-delivered, interactive science education distance learning curriculum based in the Talcott Mountain Science Center in Avon.3 First airing in January, 1985, **Scistar** received its initial funding from the Aetna Life and Casualty Insurance Company. Participating schools provide support through a $950 annual fee.

The Connecticut Department of Education, (DOE) in conjunction with Connecticut Public Television, (CPTV) is in the process of completing a statewide, two-channel, instructional television fixed service, (ITFS) to deliver instructional programming to every school district in the state.4 The system presently functions in 27 of Connecticut's 165 school districts. This limited-range, low-power network relays broadcast signals via microwave transmitters from CPTV studios in Hartford. An interested school requests participation from the DOE, which provides each school district with one free antenna and converter box that transforms the incoming ITFS signals to frequencies viewable on any conventional television set. As additional microwave transmitter towers are constructed, educational transmissions will radiate out from Hartford to other areas of Connecticut. In addition, the Connecticut Community College system has its own completed and functioning Community College Instructional Television (CCIT) microwave-delivered educational network. Lastly, a regional educational communications consortium, Area Cooperative Educational Services (ACES) provides bi-directional, fully interactive educational services to 27 school districts and over 720 students in the south-central districts.5 ACES uses a variety of communication modalities such as electronic mail and video conferencing over a fiber optic backbone to service participating school districts.

Public Act 92-146: Quality of Educational Programming Standards

Connecticut's regulatory agency, the Department of Public Utility Control, (DPUC) has recently been charged by the legislature with adopting quality standards for educational the programming provided by the state's 27 cable television (CATV) companies. The proposed legislation is meant to comprise an additional franchise renewal criterion each CATV operator must meet under the "Length of Term" section of its proposal for renewal. Each operator's location is illustrated in Table A. These proposed educational telecommunications criteria are the first of their kind to be directed toward CATV companies. Public Act 92-146, the legislative basis behind the proposed standards, is entitled An Act Concerning Educational Programming, was approved by the Connecticut General Assembly and became effective on July 1st, 1992. Sub-section (c) of The Act reads:

> For purposes of this section, educational technology shall include, but not be limited to: (1) computer-assisted instruction; (2) information retrieval and transfer; (3) data communications; (4) televised delivery of education programs, including cable, open broadcast and nonbroadcast; (5) development and acquisition of educational software, and (6) the instructional uses of television and other technologies.6

The Act is mandated for Connecticut's CATV companies, which appear due for re-regulation since recent passage of House and Senate bills by near two-thirds majorities.7 The bills may include, among other things, a provision by which franchise operators must give the franchising authority, the DPUC, in Connecticut's case, thirty days' notice for any basic programming tier rate increases exceeding five percent. Connecticut would thus effectuate the federal directives.

The DPUC will be establishing educational communications precedent as it proceeds in docketed case No. 92-07-13, DPUC Proceeding to Adopt Regulations Concerning Quality Standards for Educational Programming and Instructional Channels. Though not an educational agency, the DPUC is working with the Educational Technology Committee, a standing committee comprised of Connecticut educators representing various educational agencies and institutions, in the drafting of the proposed regulations. The DPUC is presently scheduled to publish the educational quality standards in the Connecticut Law Journal on December 1st, 1992.

Regulatory reform may be needed to support the proposed legislation. Presently, the Connecticut General Statutes define cable television service as:

....(1) the one-way transmission to subscribers of video programming or information that a community antenna television company makes available to all subscribers generally, and subscriber interaction, if any, which is required for ....video programming or....noncable communications service.8

The Connecticut General Statutes define telecommunications service as:

.... any transmission (A) between or among points specified by the user, (B) of information of the user's choosing, (B)of information of the user's choosing ....(D) by means of electromagnetic transmission including but not limited to, fiber, microwave, and satellite....9

Regulatory reform may be required since these definitions seem to define cable television transmission as one-way while telephone transmission is obviously two-ways. Distance learning is generally defined as "....instruction that originates at a site distant from that of the learner(s) and involves two-way communication by means of an interactive audio and (or) video component."10 Specifically, distance learning allows student-teacher interaction by audio modalities. Digital signal compression technologies however, facilitate both two-way video interaction and decrease transmission costs.11 A strict interpretation of the existing Connecticut statutes would delimit bi-directional, interactive, distance learning to the state's primary local exchange carrier, Southern New England Telephone. (SNET) Recent federal legislation however, has approved video data transmissions over telephone lines, but not actual educational program production.12 A strict statutory interpretation would necessitate a Connecticut CATV company's having to first obtain a certificate of public convenience and necessity from the DPUC to provide competitive intra or interexchange communications service in order to be permitted to transmit interactive educational programming. The legislative impact of Public Act 92-146 is that SNET is intensifying its efforts to add to its approximate 1,700 miles of intrastate fiber optic cable, increasing information-carrying capacity, and thus facilitating the eventual

implementation of distance learning networks.13 Lastly, as of September 1st, 1992, each Connecticut CATV company is under legal obligation to file a report with the DPUC and with each each school district superintendent on the availability of the Company's educational and local origination channels. The report must also contain an informational telephone number.

Links to Learning

SNET's Links to Learning was an interactive, bi-directional full-motion video distance learning trial that ran from September, 1988, through June, 1990 with 34 schools in 25 towns.14 Participating state school districts are illustrated in Table B. The trial used Connecticut's public switched network to transmit voice, video, and data over the Company's existing copper telephone lines. A basic classroom interactive configuration is illustrated in Tables C and D. Such a two-way interactive classroom can function either as a transmission or reception site. Links used three sophisticated technologies: full and digital compressed motion for the video link, SNET's unique packet switched network to support data collection and transfer, and a voice messaging system to support the interactive placing and receiving of messages by parents, teachers, and administrators. Although the Links trial ended in 1990, SNET has continued its involvement through the **Telecommunications Incentive Grant Program.** (**TIG**) The **TIG** provides funds typically in the $1,500 to $2,500 range for educational telecommunications projects. Grant criteria include a 20 percent funding commitment from the local community and participation in both a summer workshop and mid-year meeting.15

SNET-NFIE

SNET is currently collaborating with the National Foundation for the Improvement of Education (NFIE) in sponsoring the **Learning Tomorrow** program in Connecticut.16 An outgrowth of the Links to Learning trial, **Learning Tomorrow** is open to all K-12 public schools statewide. In March, 1992, SNET selected the Overbrook Elementary School in East Haven on the basis of several criteria to receive a SNET-NFIE $30,000 educational telecommunications grant. The grant will run from September, 1992, through June, 1994.

SNET technicians are currently meeting with Overbrook officials to construct a LAN (Local Area communications Network) to facilitate the development of educational telecommunications projects. The current plan for the SNET-Overbrook **Learning Tomorrow** effort is to tie together various computer labs with the LAN. Interactive E-Mail is a distance learning application currently being considered that would allow students to communicate in real time. The proposed Connecticut distance learning program shares certain affinities with the New York State Education Department's LAN project. That undertaking looks to equip participating classrooms with computer workstations, a teacher workstation, and with a laser printer. Each LAN would then be wired to a centralized, statewide technology network based on an IBM computer communications paradigm.17 Due in part to a projected cost in the millions, only 40 New York school systems have begun to install the necessary personal computers and LANs to configure the system, although the state legislature recently appropriated $50 million to school districts unable to afford the hardware. In Connecticut, SNET is the only regulated public utility that has been substantially involved in distance learning prior to Public Act 92-146 and the subsequent involvement of the various CATV companies.

Cable Company Involvement

Various Connecticut CATV companies have recently begun distance learning protocols. Sammons Communications of Connecticut, for example, in its April 7, 1992 Proposal for Renewal filed with the DPUC, provides for a distance learning return transmission line from the CATV company's headend, or primary transmission source, to each franchise area high school.17 In Norwich, elementary and junior high grade students recently collaborated to produce a tape that was aired over the local franchise operator's educationally dedicated return line to the Norwich Free Academy.18 Continental Cablevision, located in Connecticut's north central section, has transmitted interactive distance learning programs since 1987 and presently allocates six channels to educational access as well as nearly $500,000 in production equipment and related facilities.19 Storer Communications of Clinton, Inc., located on the Connecticut shoreline, proposed in April, 1992, a distance learning initiative calling for return

lines to all its franchise area high schools plus a substantial commitment by the Company to purchase and maintain all outside distribution plant.20 A recent DPUC decision mandated that Comcast Cablevision of Middletown, in central Connecticut, would construct one transmission path from each of the four franchise area high schools plus a fith return line to a high school outside the Company's franchise area.21 The Company, in the DPUC decision, agreed to waive the costs of expensive non-standard installations, and to assume responsibility for maintaining the transmission paths and outside plant. Connecticut's CATV operators are thus responding to the regulatory call to use advanced technologies.

Evolution of Fiber

Table E illustrates an overview of the development of fiber optic cable in CATV companies over the past four years. Though not essential for distance learning, optical fiber technology allows a signal to be carried across greater distances than with traditional copper wire, although fiber presently does not have greater carrying capacity or bandwidth than coaxial copper cable.22 Fiber optic cable reduces the number of amplification "cascades" needed to boost the signal carried over coaxial cable in order to compensate for signal degradation. One application of fiber to distance learning is the connecting of disparate educational access production studios with the franchise operator's headend, or connecting the headend with a microwave satellite dish from which an educational program is being transmitted. "Regional Hub" architecture currently being configured by many cable operators in opposition to the older "ring-based" architectures figures to facilitate centralization of various CATV services, including remote educational transmissions.23. In Connecticut, ACES uses such a fiber optic ring-based construction in its interactive learning protocols.24

Fiber and Education

Connecticut's CATV operators are beginning to use more fiber as they upgrade their extant systems to offer expanded channel capacities and greater broadband bandwidth and transmission capabilities. Numerous Connecticut CATV operators have begun to offer return line capabilities for the high schools in their franchise areas. Fiber optic capability increases the power of distance learning as the costs of the fiber and

its concomitant electronics decrease, particularly as optical switch technology continues to be perfected.25 Fiber enhances broadband capability that is necessary for interactivity. As Connecticut upgrades its communications infrastructure under the auspices of the DPUC, remote learning networks will be transmitted over existing telephone networks from online information transfer centers.26 Fiber optic cable, with its virtually limitless bandwidth, will continue to be used more prominently in cable operators' system upgrades, either in the supertrunk or the hub sites, or in both.

The DPUC's actions regarding Public Act 92-146 will have lasting educational consequences as the agency works with the state Board of Education and the Board of Governors of Higher Education to organize educational telecommunications for Connecticut students. The establishment of quality standards for instructional and educational programming in Connecticut is an exciting initial step in setting the stage for the future adoption of a standardardized plan for educational telecommunications for Connecticut. The state's distance learning initiatives figure to have applicability to both traditonal and non-traditional students, as for example, in Ohio, where a distance learning protocol allows pre-release prisoners the benefit of immediate feedback from a voice messaging remote learning program administered over telephone lines.27

Presently, there is disagreement in Connecticut regarding paying for the costs of interactive distance learning networks. Projected costs vary by CATV system, since each Company is configured uniquely. Most recently, the DPUC is considering ordering CATV operators to subsume the construction and labor expenses, while agreeing with the school systems' proposals to assume the expenses for the classroom video equipment necessary to produce the educational programming. Table F presents a hypothetical capital expenditure projection for any given Connecticut school system.28

Connecticut Distance Learning Summary

Table G presents a summary of the various remote learning technologies currently being used in Connecticut. Fiber-based technology is still expensive, but is worth the cost if the application is diversified and shared among several schools, since it is the technology that most closely replicates the normal classroom environment.29. Fiber is the

and shared among several schools, since it is the technology that most closely replicates the normal classroom environment.29. Fiber is the best transmission medium for two-way full-motion video since all the participants can hear and see each other. Connecticut's CATV companies are now beginning the initial steps toward committing to establishing remote learning networks through the use of existing coaxial return lines. Fiber optic cable is slowly making its way into the state's CATV infrastructure, but has not yet been mandated for use in educational telecommunications. Digital compression technology however, is being considered by many Connecticut cable operators. This methodology makes existing copper coaxial lines more valuable, because it has the net effect of creating more usable bandwidth.30 The ability to cram additional channels into the signal bandwidth means that the present copper lines will most likely continue to be used for some time to come.

The effect of Public Act 92-146 also means however, that Connecticut has begun to take the necessary steps to ensure that there is accountability of some kind on part of the franchise operators for the sophisticated technologies that will be shaping the instructional uses of statewide educational communications. As more non-traditional and part-time students fill the ranks of Connecticut's colleges and universities, and with regulation possibly becoming a reality, the state's CATV operators along with the franchising authority are taking the first steps in expanding the classroom via the interactive, distance learning network.31

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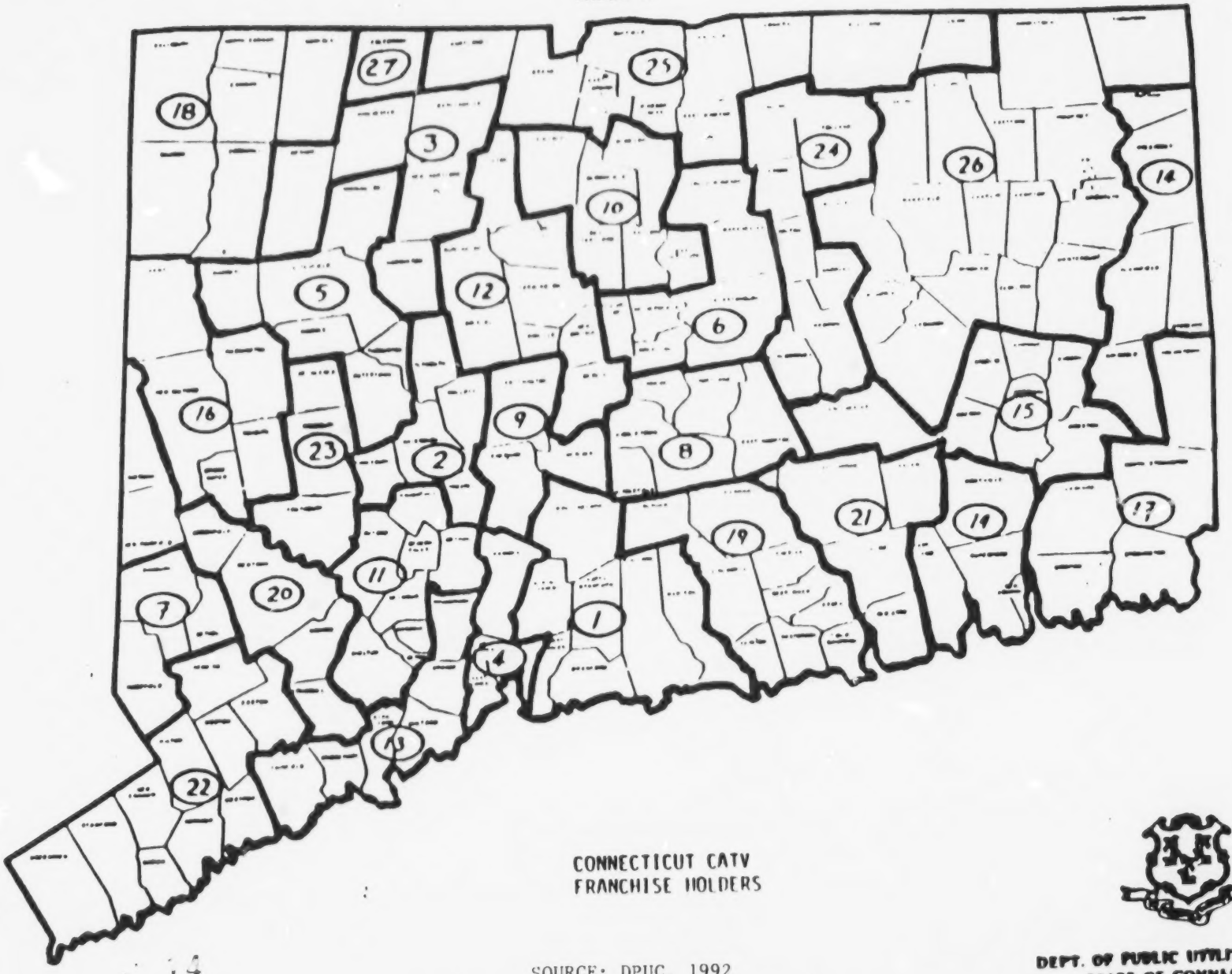
TABLE A



CONNECTICUT CATV
FRANCHISE HOLDERS

SOURCE: DPUC, 1992

DEPT. OF PUBLIC UTILITY CONTROL
STATE OF CONNECTICUT
ONE CENTRAL PARK PLAZA
NEW BRITAIN, CONN 06051

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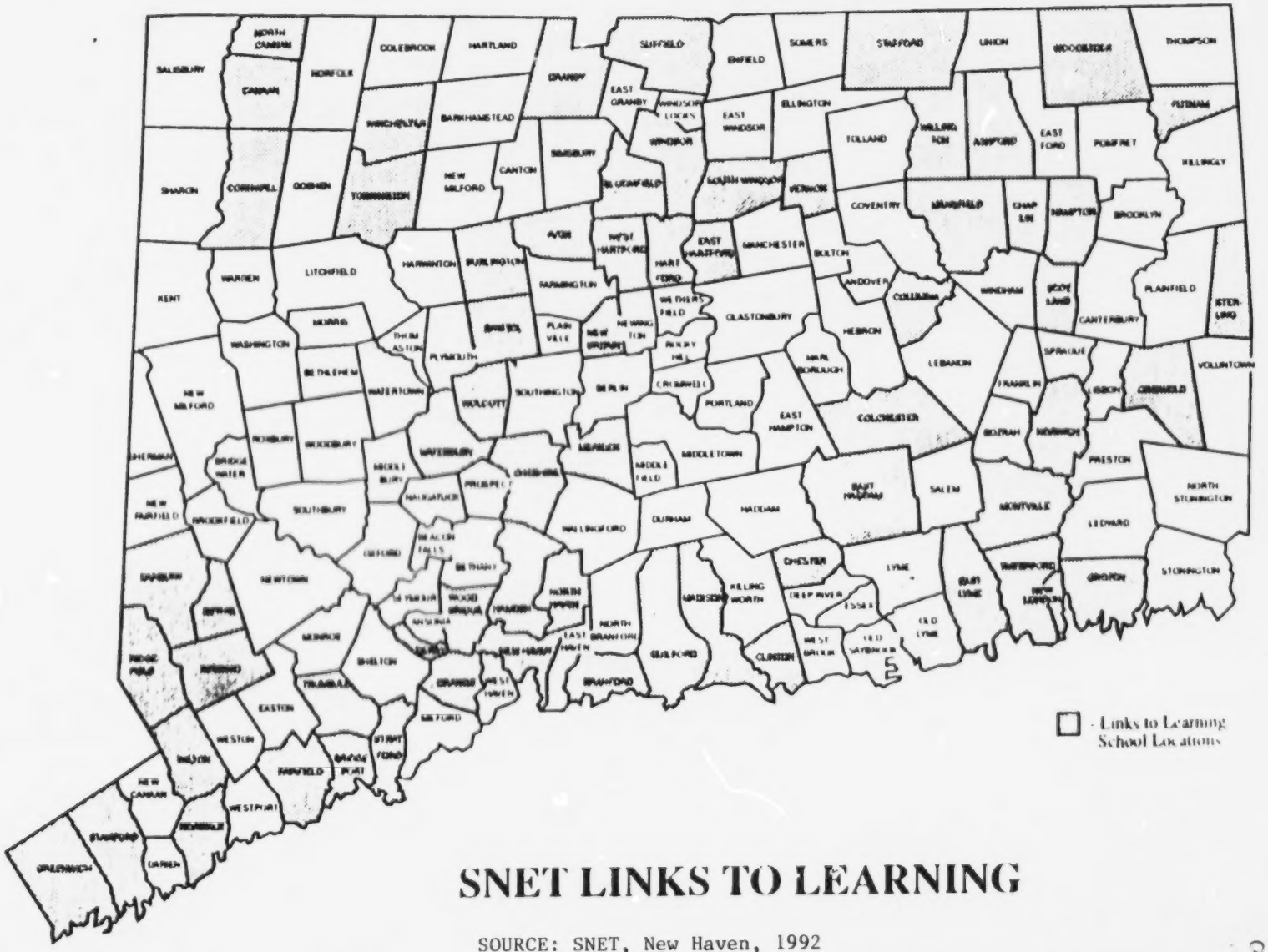
Connecticut Cable Television Companies Legend

Cable TV Company Name	Company Number
TCI Cablevision of South Central CT	1
Sammons Communications	2
Pegasus Cable Television	3
Storer Communications of Groton	4
Laurel Cablevision	5
Cox Cable of Greater Hartford	6
Comcast Cablevision of Danbury	7
Comcast Cablevision of Middletown	8
Telesystems of CT	9
United Cable of Hartford	10
Tele-Media of Western (Valley)	11
TCI Cablevision of Central CT	12
Cablevision of Southern Connecticut	13
Eastern Connecticut Cable Television	14
Century Norwich Corporation	15
New Milford Cablevision	16
Storer Communications of Groton	17
Haystack Cablevision	18
Storer Communications of Clinton	19
Housatonic Cablevison	20
Century Cable Management Corporation	21
Cablevision of Connecticut	22
Mid-Connecticut Cablevision	23
United Cable of Eastern Connecticut	24
Continental Cablevision	25
Tele-Media of Northeastern CT	26

Source: DPUC, 1992

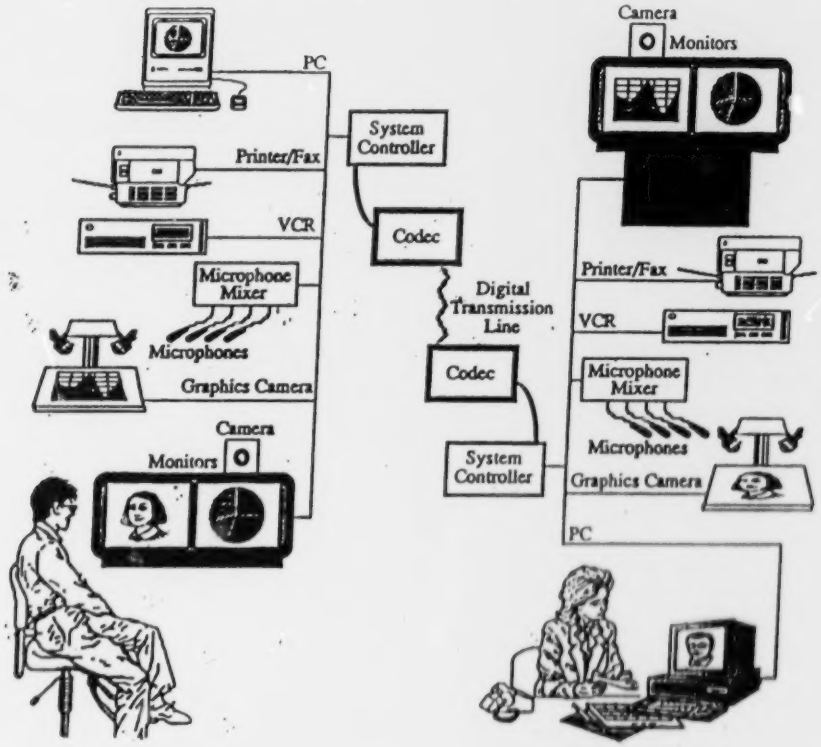
TABLE B



SNET LINKS TO LEARNING

SOURCE: SNET, New Haven, 1992

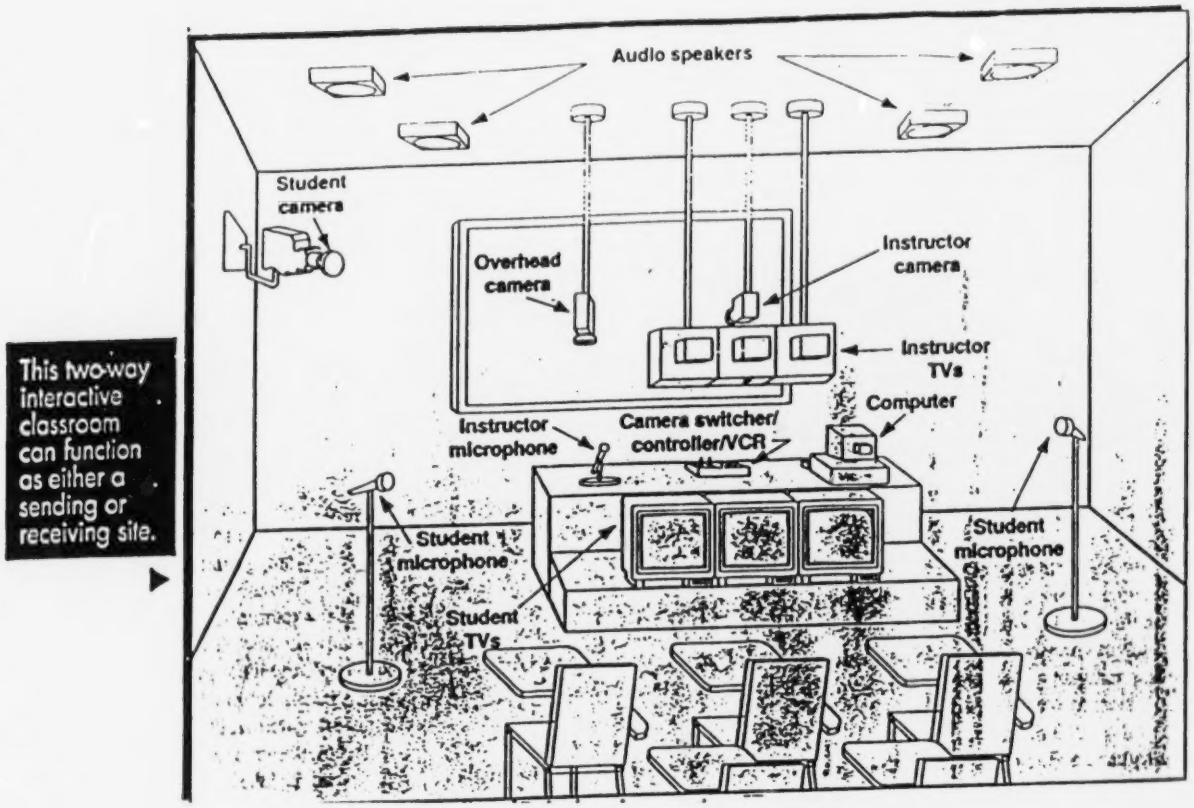
TABLE C



The basic configuration at each end includes a codec, television cameras and monitors, and an audio system. Systems can also include a room controller for adjusting camera position, audio levels, and peripheral operation.

Source: Technology Futures Inc., 1992

TABLE D



Source: Linking for Learning, Office of Technology Assessment, 1991.

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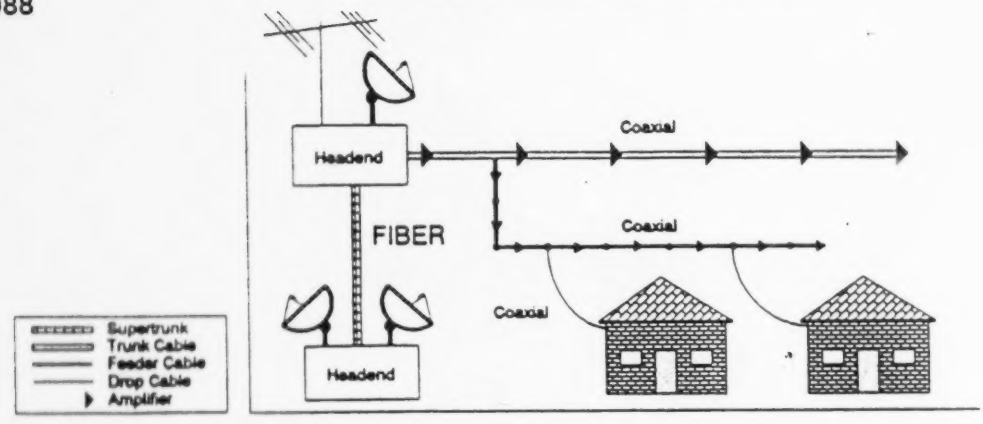
TABLE E

The Evolution of Fiber Optics in Cable

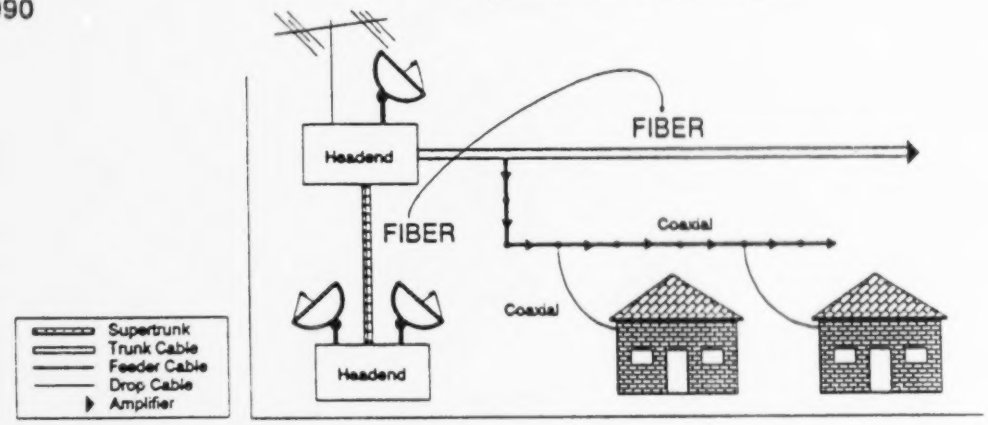
1988

System with Fiber Supertrunk



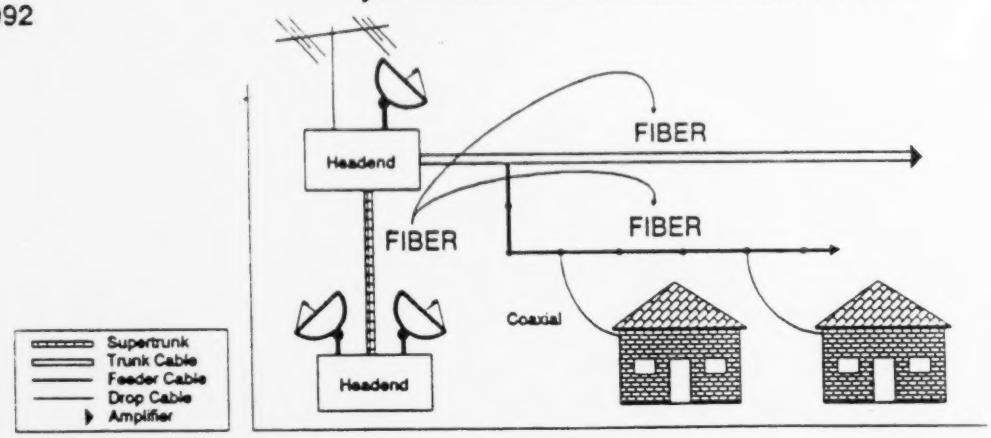
1990

System with Fiber Trunk



1992

System with Fiber Trunk and Fiber Feeders



Source: National Cable Television Association, 1992

TABLE F

CABLE CLASSROOM EQUIPMENT COSTS
Four year acquisition plan for one site

Year 1- Minimum Receiving Site	5,375.
Year 2- Fully Equipped Receiving Site	4,425.
Year 3- Minimum Origination Site	4,890.
Year 4- Fully Equipped Origination Site	995.
	$15,685.

Cable company pays for:	
"Upstream" modulator	2,250.
Headend demodulator	2,300.
Programmable timer	700.
Switching matrix	400.
	$5,650.

Source: Middlesex Distance Learning Consortium, 1990

TABLE G

Summary of Distance Learning Technologies

- Voice teleconferencing
- Audio-graphics teleconferencing
- One-way satellite / cable networks (public)
- Microwave networks (private)
- Compensated-motion (compressed) video
- Full-motion video using digital fiber

Source: Northern Telecom, 1991